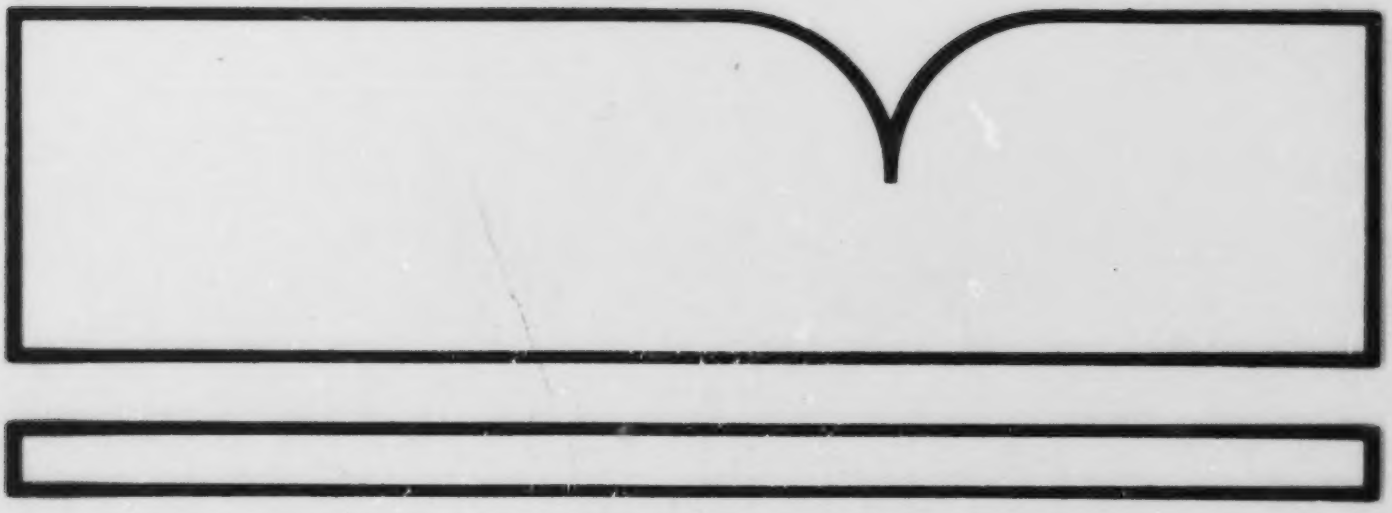
PB85-175701

Contaminant Analysis of 1982 Fall Run Coho Salmon ('Oncorhynchus kisutch')

(U.S.) Environmental Protection Agency
Chicago, IL

Apr 84



U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-905/3-84-004		PB85 175701/AS

4. TITLE AND SUBTITLE	5. REPORT DATE
Contaminant Analysis of 1982 Fall Run Coho Salmon (Oncorhynchus Kisutch)	April, 1984
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
David S. DeVault and Joseph A. Weishaar	
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
U.S. Food and Drug Administration Department of Health and Human Services 240 Hennepin Avenue Minneapolis, Minnesota	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
U.S. Environmental Protection Agency Great Lakes National Program Office 536 South Clark Street Chicago, Illinois 60605	Research 1982
	14. SPONSORING AGENCY CODE Great Lakes National Program Office-USEPA Region V

15. SUPPLEMENTARY NOTES

16. ABSTRACT

ABSTRACT

Skin-on coho salmon fillets from Lakes Huron, Michigan, Erie and Ontario were analyzed under a cooperative agreement between the U.S. Environmental Protection Agency, the U.S. Food and Drug Administration and the states of Pennsylvania, New York, Ohio, Michigan, Indiana and Illinois. Results indicate that the highest concentrations of pesticides and industrial compounds occurred in coho from Lake Ontario and lowest in Lake Erie. Tissue residue levels were below U.S. Food and Drug Administration action levels for all compounds with the exception of mirex and PCB in Lake Ontario. Mirex exceeded the action level of 0.1 ug/g in each of the 3 composite samples from Lake Ontario. The Lake Ontario samples also exceeded the 2.0 ug/g action level for total PCB. Comparison of the 1982 data with that collected in 1980 indicate significantly ($P<.05$) lower levels of DDT, PCB and chlordane in the 1982 samples from Lakes Michigan and Huron. PCB has declined significantly in Lake Erie coho.

microgram/g

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Coho salmon PCB DDT contaminant Fish contaminant		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Document is available to the public through the National Technical Information Service (NTIS), Springfield, VA 22161		26
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (9-73)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1985—555-187/507

FOREWORD

The Great Lakes National Program Office (GLNPO) of the U.S. Environmental Protection Agency was established in Region V, Chicago to focus attention on the significant and complex natural resource represented by the Great Lakes.

GLNPO implements a multi-media environmental management program drawing on a wide range of expertise represented by universities, private firms, State, Federal and Canadian governmental agencies and the International Joint Commission. The goal of GLNPO is to develop programs, practices and technology necessary for a better understanding of the Great Lakes system and to eliminate or reduce to the maximum extent practicable the discharge of pollutants into the Great Lakes system. The GLNPO also coordinates U.S. actions in fulfillment of the Agreement between Canada and the United States of America on Great Lakes Water Quality of 1978.

This study was carried out under a cooperative agreement between GLNPO, U.S. Food and Drug Administration (USFDA) and the States of Ohio, Michigan, New York, Pennsylvania, Illinois, Indiana and Wisconsin. The samples were collected by state personnel and analyzed by USFDA. Data analysis and program coordination was provided by GLNPO.

ABSTRACT

Skin-on coho salmon fillets from Lakes Huron, Michigan, Erie and Ontario were analyzed under a cooperative agreement between the U.S. Environmental Protection Agency, the U.S. Food and Drug Administration and the states of Pennsylvania, New York, Ohio, Michigan, Indiana and Illinois. Results indicate that the highest concentrations of pesticides and industrial compounds occurred in coho from Lake Ontario and lowest in Lake Erie. Tissue residue levels were below U.S. Food and Drug Administration action levels for all compounds with the exception of mirex and PCB in Lake Ontario. Mirex exceeded the action level of 0.1 ug/g in each of the 3 composite samples from Lake Ontario. The Lake Ontario samples also exceeded the 2.0 ug/g action level for total PCB. Comparison of the 1982 data with that collected in 1980 indicate significantly ($P<.05$) lower levels of DDT, PCB and chlordane in the 1982 samples from Lakes Michigan and Huron. PCB has declined significantly in Lake Erie coho.

United States
Environmental Protection
Agency

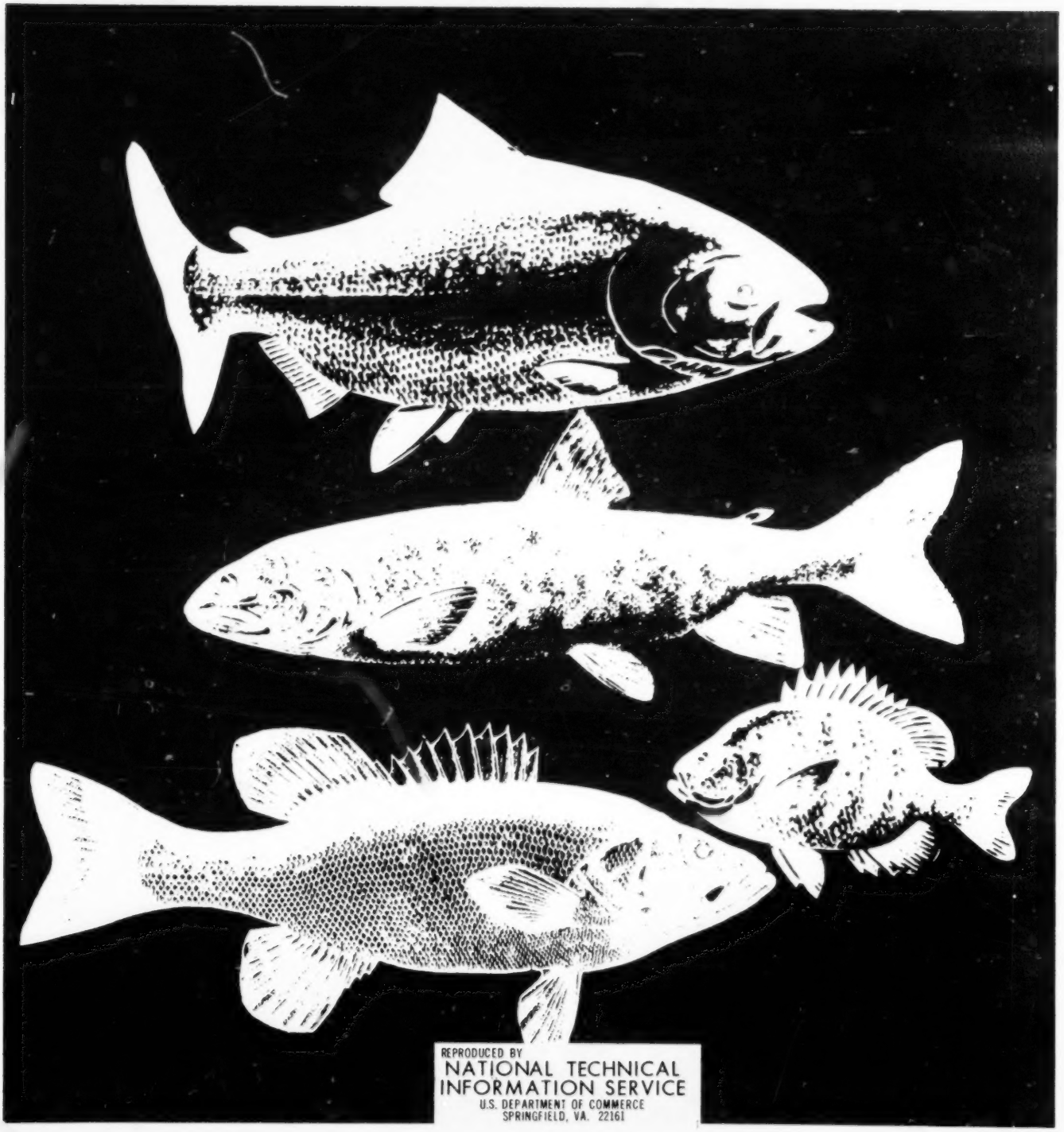
Great Lakes National
Program Office
536 South Clark Street
Chicago, Illinois 60605

EPA-905/3-84-004

PB85-175701

EPA

Contaminant Analysis Of 1982 Fall Run Coho Salmon (OHCORHYNCHUS KISUTCH)



REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

EPA 905/3-84-004
April, 1984

Contaminant Analysis of 1982 Fall Run Coho Salmon (*Oncorhynchus kisutch*)

by

David S. DeVault

U.S. Environmental Protection Agency
Great Lakes National Program Office

and

Joseph A. Weishaar

U.S. Food and Drug Administration
Department of Health and Human Services
240 Hennepin Avenue
Minneapolis, Minnesota 55401

For

U.S. Environmental Protection Agency
Great Lakes National Program Office
536 South Clark Street
Chicago, Illinois 60605

DISCLAIMER

This report has been reviewed by the Great Lakes National Program Office, U.S. Environmental Protection Agency (USEPA), and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the USEPA, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Contents

	Page
Foreward	ii
Abstract	iii
Figures and Tables	v
Acknowledgements	vi
Introduction	1
Methods	2
Results and Discussion	6
References	16

Figures

Page

Figure 1 Tributary Locations for 1982 Coho Salmon Collection 3

Tables

Table 1 Coho Salmon Sample Data - 1982 Collections..... 4

Table 2 Contaminant Data From the 1982 Coho Salmon Collections..... 7

Table 3 Mean Contaminant Concentrations in 3 Year Old Coho Salmon Composites 1982..... 10

Table 4 Comparison of 1980 and 1982 Mean Levels for Major Contaminants..... 14

Acknowledgements

We thank the many people in the Fisheries and Natural Resource Department of the States of Illinois, Indiana, Michigan, Ohio, Pennsylvania and New York who collected samples for this program. We also thank Dr. James Clark, USEPA, Environmental Research Laboratory, Gulf Breeze, Florida; Dr. Ronald Sloan, New York State Department of Environmental Conservation; and Dr. Ronald Rossmann, University of Michigan for reviewing and commenting on the report. We also thank Ms. Lois J. Payne and Ms. Gaynell Whatley for typing the manuscript and tables.

Introduction

Fish contaminant monitoring programs have been implemented by state and federal agencies throughout the Great Lakes Basin with varying levels of intensity. The Great Lakes Fish Monitoring Program (GLFMP) was designed and implemented to provide interagency coordination and cooperation for gathering information on the contaminant problem in the Great Lakes (GLNPO 1981). In an effort to address the potential public health concerns associated with contaminants in major game fish from each of the Great Lakes, one element of the Great Lakes Fish Monitoring Strategy calls for the collection and analysis of fall run coho salmon (Oncorhynchus kisutch).

Coho salmon were chosen for contaminant monitoring because of their popularity as a sport fish, rapid growth rates and migratory behavior. Coho move about the nearshore and open water areas of a lake while maturing and are exposed to contaminants from numerous sources. As a fast growing, terminal predator in the Great Lakes, coho salmon consume large quantities of alewife and other forage fish. They may, therefore, accumulate chlorinated organics and other contaminants both through direct absorption and the food chain. Numerous coho salmon of a uniform age group can be sampled relatively easily as mature fish return to tributaries to spawn at the end of their three year life cycle. Also, their three year life span provides an indication of contaminant problems over the recent past, as opposed to the extended picture given by more long lived species such as lake trout (Salvelinus namaycush).

Papers have been prepared for data generated by this program in 1980 (Clark et al. 1984) and 1981 (DeVault and Weishaar 1983). This paper presents the 1982 data as well as a comparision of current contaminant levels with those observed in the first year of the program (1980).

Methods

State agency personnel collected adult coho salmon using nets and other conventional equipment as the fish began their fall, upstream migrations in 1982. Where sufficient fish were available, 15 adult coho salmon were collected at each site (Figure 1) and composited 5 fillets per sample. Two year old fish supplemented the Kellogg Creek and Platte River (Lake Michigan), and Detroit River (Lake Erie) collections. The age, mean lengths, weghts and ranges for fish yielding fillets are listed in Table 1. The collecting agency froze the fish samples and shipped them to the U.S. Food and Drug Administration's (USFDA) laboratory in Minneapolis, Minnesota for analysis. All samples were standard skin-on fillets (GLNPO 1981).

The fillets in each sample were ground into a uniform tissue homogenate. An aliquot of this homogenate was weighed and analyzed for contaminat residues according to the USFDA Pesticide Analytical Manual (USFDA 1980). Contaminants were triple extracted from the fish tissue in petroleum ether and fats separated from the sample using petroleum ether/acetonitrile partitioning. The sample preparations were then added to an activated Florisil column. Three solutions of increasing polarity were put through the column providing distinct preparations for analysis with interferences due only to interactions of individual and multipeak contaminants within each extract.

Mirex and 8-monohydromirex (photomirex) were determined by a combination of official and collaborated methods. This involved the triple extraction of the contaminants from the fish tissue in petroleum ether with fats separated from the samples using an unactivated Florisil column. The mirex and 8-monohydromirex were partially separated from the other contaminants using an activated Florisil column. Additional clean up was by a nitration process followed by an alumina column as described by Norstrom et al. (1980).

Figure 1: Tributary locations for 1982 Coho Salmon collections

TABLE 1 COHO SALMON SAMPLE DATA - 1982 COLLECTIONS

Collection Site and Date	Sample #	#Fish Composited	Age	Mean Length MM (Range)	Mean Weight KG Range	% Lipid
Lake Huron						
Tawas River	1	5	3	587(354-670)	2.31(0.50-2.90)	4.9
Michigan	2	5	3	666(660-670)	3.27(3.00-3.50)	4.0
9/30/82	3	5	3	707(685-720)	3.92(3.54-4.45)	4.2
Lake Michigan						
Trail Creek	1	5	3	586(493-637)	2.18(1.30-2.61)	2.8
Indiana	2	5	3	630(622-640)	2.72(2.63-2.83)	4.0
10/4-14/82	3	5	3	670(637-744)	3.41(2.95-4.08)	4.6
Kellogg Creek	1	5	2/3	526(440-600)	1.51(1.00-2.20)	0.9
Illinois	2	5	3	603(555-655)	2.81(1.85-2.60)	1.4
11/10-19/82	3	5	3	646(625-665)	2.90(2.75-3.25)	1.7
Platt River	1	5	2/3	578(550-605)	1.51(1.25-1.85)	0.8
Michigan	2	5	2/3	636(625-661)	2.17(2.00-2.50)	1.0
9/30/82	3	5	2/3	679(665-712)	3.06(2.50-3.57)	0.8
Lake Erie						
Detroit River	1	5	2	622(540-651)	2.16(1.67-3.02)	0.5
Michigan	2	5	2	664(648-681)	3.23(3.05-3.40)	1.3
11/02/82	3	5	2/3	708(683-732)	3.69(3.47-3.89)	1.0
Huron River	1	5	3	593(546-612)	2.02(1.75-2.24)	2.0
Ohio	2	5	3	630(583-675)	2.49(2.35-2.60)	2.7
10/15/82	3	5	3	674(619-745)	3.07(2.60-3.99)	1.6
Chagrin River	1	5	3	618(597-635)	2.65(2.38-2.83)	7.1
Ohio	2	5	3	649(630-673)	3.06(2.83-3.29)	5.6
10/25/82	3	5	3	668(648-711)	3.67(3.40-3.96)	5.4
Trout Run Tributary	1	5	3	560(525-600)	1.77(1.50-2.07)	3.0
Pennsylvania	2	5	3	623(590-650)	2.33(2.13-2.44)	1.4
10/13/82	3	5	3	643(610-690)	2.68(2.47-3.12)	2.6
Lake Ontario						
Salmon River	1	5	3	756(732-767)	4.28(4.00-4.55)	2.3
New York	2	5	3	786(757-810)	5.08(4.65-5.75)	1.2
11/03/82	3	5	3	815(796-825)	5.72(5.49-5.82)	2.0

Organochlorines were quantified on a Hewlett-Packard gas-liquid chromatograph using a Nickel-63 electron capture detector.

Analytical grade standards and pesticide grade solutions were used in the analysis. Analytical quantitation limits were 0.005 ug/g for DDT, chlordane components, endrin and mirex, and 0.10 ug/g for PCB. A series of chlorinated chemicals resembling toxaphene were quantified when present at 0.25 ug/g or greater using a toxaphene standard. Several pesticides and industrial compounds which were present at low concentration were not quantified unless present at concentrations above 0.05 ug/g, although detection limits were 0.005 ug/g or less. All fish tissue concentrations were computed on a ug/g wet weight basis and not corrected for extraction or recovery efficiency. Standard USFDA quality control procedures were followed throughout (USFDA 1980).

For purposes of graphical display and numerical calculations, concentrations below quantitation limits and above detection limits were assumed to be 1/2 the quantitation limits. Concentrations below the instrument detection limits were calculated as 0.

Results and Discussion

Laboratory analysis indicated the presence of 25 pesticides and industrial compounds in the 27 coho salmon samples analyzed (Table 2). These included pesticides currently in use in the Great Lakes Basin and substances whose use has been banned or severely restricted. Table 2 includes data on composites of both two and three year old fish, while Table 3 and the following discussion compare only 3 year old coho as these are most directly comparable and represent the highest contaminant concentrations. The Lake Michigan 3 year old data set consists of only 3 samples from Trail Creek and 2 samples from Kellogg Creek due to the large number of 2 year olds collected at the Michigan sites (Table 1).

PCBs were the most prominent contaminant found (Table 2). Total PCBs were highest in three year old coho from Lake Ontario with an average of 2.65 ug/g. Lake Michigan 3 year olds averaged 0.83 ug/g while both Lake Erie and Lake Huron averaged 0.67 ug/g (Table 3). Aroclor 1254 was the predominate Aroclor mixture comprising between 60 percent and 80 percent of the total PCB burden across the entire data set.

Total PCB concentrations exceeded the USFDA action level only in Lake Ontario where all samples were above the USFDA action level of 2.0 ug/g total PCB.

Total p,p-DDT concentration varied widely between lakes with 3 year old coho from Lake Erie averaging 0.10 ug/g and Lake Ontario 0.57 ug/g.

Table 2

Contaminant Data From the 1982 Coho Salmon Collections

	Lake Michigan								
	Trail Creek, IN			Kellogg Creek, IL			Platte River, MI		
Aroclor 1242	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	<0.10	<0.10	0.24	<0.10	<0.10	0.22	<0.10	0.14	0.17
Aroclor 1254	0.37	0.47	0.87	0.38	0.36	0.81	0.26	0.52	0.61
Aroclor 1260	<0.10	0.12	0.22	<0.10	<0.10	0.20	<0.10	0.13	0.15
Total PCB	0.47	0.64	1.33	0.48	0.46	1.23	0.36	0.79	0.93
P,P'-DDE	0.15	0.18	0.38	0.19	0.17	0.38	0.11	0.25	0.33
P,P'-DDD	<0.005	<0.005	0.03	<0.005	<0.005	<0.005	<0.005	0.02	0.02
P,P'-DDT	<0.005	<0.005	<0.005	0.02	0.03	0.03	<0.005	0.02	0.01
Total DDT	0.155	0.185	0.4125	0.2125	0.2025	0.4125	0.115	0.29	0.36
Apparent toxaphene	0.3	0.4	0.6	0.6	0.9	1.2	0.3	0.6	0.5
Hexachlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dachal	<0.05	<0.05	<0.05	ND	ND	0.05	ND	ND	ND
Dieldrin	0.02	0.05	<0.05	0.01	0.01	0.02	<0.05	0.02	0.01
Endrin	<0.005	<0.005	<0.005	ND	<0.005	<0.005	ND	<0.005	<0.005
A-BHC	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
G-BHC(lindane)	<0.05	<0.05	<0.05	<0.05	<0.05	ND	ND	ND	ND
Trans nonachlor	0.02	0.02	0.05	0.01	0.03	0.04	0.01	0.03	0.03
Cis nonachlor	<0.005	<0.005	0.02	<0.005	<0.005	0.02	<0.005	0.02	0.02
Cis chlordane	0.01	0.02	0.03	0.01	0.01	0.02	0.01	0.02	0.02
Trans chlordane	0.01	0.01	0.01	0.01	0.02	0.02	<0.005	0.01	0.01
Octachlor epoxide	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	0.01
Total chlordane	0.045	0.055	0.1125	0.035	0.065	0.1025	0.0275	0.09	0.09
Heptachlor epoxicde	<0.005	<0.005	<0.005	ND	ND	ND	<0.005	<0.005	<0.005
Pentabhlorophenyl methyl ether	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trifluralin	ND	ND	ND	<0.05	<0.05	<0.05	ND	ND	ND
Mirex	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Monohydromired (Photomirex)	NA	NA	NA	NA	NA	NA	NA	NA	NA

ND = Not Detected
NA = Not Analyzed

Table 2 (continued)

Contaminant Data From the 1982 Coho Salmon Collections

	Detroit River, MI			Huron River			Chargin River, OH			Trout Run Tributary, PA		
Aroclor 1242	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1254	0.17	0.43	0.18	0.37	0.41	0.49	0.65	0.58	0.50	0.58	0.34	0.63
Aroclor 1260	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	0.16	0.14	0.13	0.15	<0.10	0.16
Total PCB	0.27	0.53	0.28	0.47	0.51	0.66	0.86	0.77	0.68	0.78	0.44	0.84
P,P-DDE	0.02	0.04	0.02	0.05	0.05	0.07	0.09	0.07	0.07	0.06	0.04	0.06
P,P-DDD	0.02	0.04	0.02	0.02	0.03	0.04	0.05	0.05	0.05	0.04	0.02	0.04
P,P-DDT	<0.005	<0.005	<0.005	<0.005	0.01	0.01	0.01	0.01	0.01	<0.005	<0.005	<0.005
Total DDT	0.0425	0.0825	0.0425	0.0725	0.09	0.12	0.15	0.13	0.13	0.1025	0.0625	0.1025
Apparent toxaphene	<0.25	<0.25	<0.25	0.3	0.3	0.5	0.4	0.4	0.4	<0.25	<0.25	<0.25
Hexachlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dachal	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	<0.005	0.01	<0.005	0.01	0.01	0.02	0.03	0.02	0.03	0.02	0.01	0.02
Endrin	ND	<0.005	<0.005	ND	ND	ND	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
A-BHC	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
G-BHC (lindane)	ND	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	ND	ND	ND
Trans nonachlor	<0.005	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.02	0.02	0.01	0.02
Cis nonachlor	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	0.01	0.01	<0.005	<0.005	<0.005
Cis chlordane	<0.005	0.01	<0.005	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01
Trans chlordane	<0.005	<0.005	<0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.005	<0.005
Octachlor epoxide	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total chlordane	0.012	0.0375	0.020	0.035	0.035	0.036	0.0725	0.0625	0.0625	0.055	0.0275	0.0375
Heptachlor expoxide	<0.005	<0.005	<0.005	ND	ND	ND	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Pentachlorophenyl methyl ether	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.005
Trifluraline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mirex	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Monohydromirex 8 (photomirex)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

ND = Not Detected
NA = Not Analyzed

Table 2 (continued)

Contaminant Data From the 1982 Coho Salmon Collections

	Lake Huron, Tawas River, MI			Lake Ontario, Salmon River, NY		
Aroclor 1242	ND	ND	ND	ND	ND	ND
Aroclor 1248	<0.10	<0.10	<0.10	0.58	0.40	0.44
Aroclor 1254	0.46	0.54	0.51	2.14	1.45	1.63
Aroclor 1260	0.11	0.13	0.13	0.53	0.36	0.41
Total PCB	0.62	0.72	0.69	3.25	2.21	2.48
P,P-DDE	0.20	0.16	0.18	0.48	0.42	0.50
P,P-DDD	0.01	0.01	0.01	0.06	0.04	0.05
P,P-DDT	0.02	0.02	0.02	0.06	0.04	0.05
Total DDT	0.23	0.19	0.21	0.60	0.50	0.60
Apparent toxaphene	1.0	0.8	0.7	1.0	0.7	0.8
Hexachlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dachal	<0.05	<0.05	<0.05	ND	ND	ND
Dieldrin	0.03	0.02	0.03	0.03	0.01	0.02
Endrin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
A-BHC	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
G-BHC (lindane)	<0.05	<0.05	<0.05	ND	ND	ND
Trans nonacholor	0.02	0.02	0.02	0.05	0.03	0.04
Cis nonachlor	0.01	0.01	0.02	0.03	0.02	0.03
Cis chlordane	0.02	0.02	0.02	0.03	0.02	0.03
Trans chlordane	0.01	0.01	<0.005	0.01	0.01	0.01
Octachlor epixide	0.01	<0.005	<0.005	0.02	0.01	0.01
Total chlordane	0.07	0.0625	0.065	0.14	0.09	0.12
Heptachlor epoxide	<0.005	<0.005	<0.005	ND	ND	ND
Pentachlorophenyl methyl ether	<0.05	<0.05	<0.05	ND	ND	<0.05
Trifluralin	ND	ND	ND	ND	ND	ND
Mirex	NA	NA	NA	0.17	0.15	0.16
8-Monohydromirex (Photomirex)	NA	NA	NA	0.08	0.06	0.07

Table 3

Mean Contaminant Concentrations in 3 Year

Old Coho Salmon Composits - 1982

Mean (Standard error) in ug/g

Lake	Number of Samples	Total PCB	Total DDT	Total Chlordane	"Apparent Toxaphene"	Weight (kg)
Michigan	5	0.83 (0.19)	0.27 (0.06)	0.08 (0.01)	0.68 (0.16)	2.68 (0.23)
Huron	3	0.67 (0.03)	0.21 (0.01)	0.07 (0.004)	0.83 (0.09)	3.17 (0.47)
Erie	9	0.67 (0.05)	0.10 (0.01)	0.04 (0.02)	0.03 (0.05)	2.64 (0.19)
Ontario	3	2.65 (0.31)	0.57 (0.03)	0.12 (0.01)	0.83 (0.09)	5.03 (0.41)

Mean concentrations in Lake Huron and Michigan were intermediate at 0.21 ug/g and 0.27 ug/g respectively. The dominate form was pp-DDE which comprised between 47 and 97 percent of the total pp-DDT.

Total chlordane in three year old coho composites ranged from 0.05 ug/g in Lake Erie to 0.12 ug/g in Lake Ontario (Table 3). Lake Huron and Lake Michigan were intermediate with 0.07 ug/g and 0.08 ug/g respectively. While the components of technical chlordane were present in all samples (Table 2), total chlordane was well below the USFDA action level of 0.3 ug/g.

As in 1980 (Clark et al. 1984) and 1981 (DeVault and Weishaar 1983), a series of chlorinated chemicals with chromatographic characteristics similar to toxaphene were found in all samples. Toxaphene standards were used for quantitation, however, several of the peaks in the standards were consistantly absent from the sample chromatograms. Mean concentrations of "apparent toxaphene" in 3 year old coho ranged from 0.03 ug/g in Lake Erie to 0.83 ug/g in both Lakes Ontario and Huron.

As the pesticide mirex has been routinely found in the Lake Ontario Basin (Veith, et al. 1979, Clark et al. 1984) only the Lake Ontario samples were analyzed for Mirex and its photodegradation product, 8-monohydromirex (photomirex). Mirex ranged from 0.15 ug/g to 0.17 ug/g, and 8-monohydromirex (photomirex) ranged from 0.06 ug/g to 0.08 ug/g (Table 2). Mirex was substantially above the 0.10 ug/g USFDA action level in all the Lake Ontario coho samples.

Several pesticides and industrial compounds occurred at low levels throughout the basin (Table 2). These included hexachlorobenzene, dieldrin, A-BHC(HCH), pentachlorophenylmethyl ether, and octachlor epoxide. Lindane was detected at <0.05 ug/g at all sites except the Platte River (Lake Michigan),

Trout run tributary (Lake Erie) and Salmon River (Lake Ontario). Endrin was detected at <0.005 ug/g at all sites with the exception of the Huron River (Lake Erie).

Highest mean concentrations of DDT, PCB, and chlordane were observed in three year old coho from Lake Ontario and the lowest in Lake Erie. However, comparisons of the relative concentrations of contaminants found at various sites must be tempered by the fact that neither the size, nor the sexual composition of our samples were held constant. Contaminant concentrations are known to increase with size and exposure period, (age) and recent information indicates that in the fall, male coho may exhibit higher contaminant concentrations than females (NYDEC 1982). While the effects of age have been eliminated by comparing only three year old fish, the size of the fish and sexual composition of our composite samples varied from site to site. The smallest coho were obtained from Lake Erie and the largest from Lake Ontario (Table 1). The higher concentrations of contaminants in the Lake Ontario samples may reflect the more rapid growth rates and larger fish as well as high levels of contaminant inputs. The lower contaminant contaminant levels in Lake Erie coho may reflect the smaller fish collected there as well as the high level of productivity and sedimentation which may bind up hydrophobic contaminants and remove them from the system before they find their way into the top carnivore fishes.

While trend monitoring of contaminant levels are not among the goals of this element of the GLFMP, it is interesting to compare the 1982 data with that of 1980. Table 4 gives the mean and standard error for major contaminants in each lake in 1980 and 1982. Only sites at which data for 3 year old coho were available for both years were included to avoid possible effects

Table 4

Comparison of 1980 and 1982 Mean Levels for Major Contaminants
Mean (Standard Error)

	Lake Michigan		Lake Huron		Lake Erie		Lake Ontario	
	1980	1982	1980	1982	1980	1982	1980	1982
Weight	3.49 (0.19)	2.68(0.14)**	4.05 (0.27)	3.17 (0.47)	2.37 (0.32)	2.64(0.19)	4.68(0.42)	5.03(0.41)
DDT	0.67 (0.08)	0.36(0.09)*	0.41 (0.02)	0.21 (0.01)**	0.265(0.11)	0.169(0.06)	0.57(0.33)	0.79(0.12)
PCB	1.90 (0.15)	0.79(0.17)**	1.93 (0.05)	0.68 (0.03)**	1.02 (0.07)	0.67(0.05)**	3.23(0.31)	2.65(0.31)
Chlordane	0.175(0.01)	0.08(0.01)**	0.130(0.01)	0.068(0.002)**	0.06 (0.004)	0.05(0.006)	0.18(0.02)	0.12(0.01)
Number of Samples	6	5	3	3	9	9	3	3

*Difference significant at P<.05
**Difference significant at P<.01

due to geographical variation. It is readily apparent that in most cases mean contaminant concentrations observed in 1982 were lower than those in 1980. To test the significance of this apparent decrease, the data (pooled by lake) for 1980 and 1982 were compared using a two sample T-test (Zar 1974). This analysis (Table 4) indicated statistically significant decreases in DDT concentrations in Lakes Michigan and Huron, PCB concentrations in Lakes Michigan, Huron, and Erie as well as chlordane in Lake Michigan and Huron. Mean concentrations of PCB, and chlordane declined in all lakes between 1980 and 1982, though only those changes discussed above were statistically ($P<.05$) significant.

It is important that care be taken in the interpretation of these results. While the effects of age have been eliminated by comparing only 3 year old fish, the size and sexual composition of our collections varied from year to year. In fact the mean weight of Lake Michigan coho was significantly ($P<.05$) lower in 1982 than 1980. Regression analysis of the pooled 1980 and 1982 Lake Michigan data yielded the following results when weight was used as predictor of DDT, PCB and chlordane concentrations.

PCB (ug/g) = 0.98 X weight (kg) - 1.67
R^2 = 67.3 F = 18.55 DF = 1/9 P<.01

DDT (ug/g) = 0.279 X weight (kg) - 0.341
R^2 = 42.4 F = 6.62 DF = 1/9 P<0.1

Chlordane (ug/g) = 0.081 X weight (kg) - 0.121
R^2 = 66.7 F = 18.0 DF = 1/9 P<.01

The decreased weight of the 1982 Lake Michigan samples is therefore a possible contributary factor in the decline in contaminant concentrations in coho from that Lake. The lipid content of our samples may also have varied between 1980 and 1982. Unfortunately lipid was not determined in 1980, precluding evaluation of the effect of possible changes on observed contaminant concentrations.

No assessment of trends in contaminant levels prior to 1980 was attempted, however, the contemporary residue levels are generally less than those reported in the 1960's and early 1970's (IJC 1978). Other fish collections have been designed to specifically address trends in residue levels in open lake fish (lake trout and smelt, whole fish preparation) as part of the Great Lakes Fish Monitoring Program. These results will be reported at a later date.

References

Armstrong, R. W. and R. J. Sloan. 1980. Trends in levels of several known chemical contaminants in fish from New York State Waters. New York State Department of Environmental Conservation. Albany, New York June 1980. 77p.

Clark, J. R., D. DeVault, R. J. Bowden, and J. A. Weishaar. 1982. Contaminant analysis of fall run coho salmon. J. Great Lakes Res. 10:38-47.

DeVault, D.S. and J.A. Weishaar, 1983. Contaminant anslysis of 1981 Fall Run Coho Salmon (Onchorhynchus Kisutch). U.S. EPA. Great Lakes National Program, EPA 905/3-83-001. 16p

Great Lakes National Program Office (GLNPO). 1981. A strategy for fish contaminant monitoring in the Great Lakes. USEPA, Great Lakes National Program Office, Chicago, Illinois.

IJC. 1978. Great Lakes water quallity status report, Appendix E. Great Lakes Water Quality Board. Windsor, Ontario, Canada.

New York Department of Environmental Conservation (NYDEC). 1982. Toxic substances in fish and wildlife. November 1, 1981 to April 30, 1982. Technical Report 82-2 (BEP) June 1982. NYDEC. Albany, New York.

Norstrom, R.J., H.T. Won, M.O.H. Holdrin, P.G. Calway and C.D. Naftel. 1980. Gas liquid chromatographic determination of Mirex and Photomirex in the pressence of Polychlorinated biphenyls. J. Assoc. Of. Anal. Chem. 63:53-59.

Ohio Department of Natural Resources. 1980. 1979 status of PCB's in Lake Erie fishes. ODNR Communication, Columbus, Ohio.

Rohrer, T. K., J. C. Forney and J. H. Hartig. 1982. Organochlorine and heavy metal residues in standard fillets of coho and chinook salmon of the Great Lakes - 1980. Journal of Great Lakes Reseach 8:623-634.

U.S. Food and Drug Administration (USFDA) 1980. USFDA Pesticide Analytical Manual. U.S. Department of Health and Human Services, Washington, D.C.

Veith, G. D., D.W. Kuehl, E. N. Leonard, K. Welch and G. Pratt. 1981. Polychlorinated biphenyls and other chemical residues in fish from major watersheds near the Great Lakes, 1978. Pestic. Monit. J. 5:1-8.

Zar, J. H. 1974. Biostatiscal Analysis. Prentice Hall Inc. Englewood Cliffs, New Jersey, 580p.